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BULLETIN NO. 144 FEBRUARY, 1909

ALABAMA

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute

AUBURN.

THE SAN JOSE SCALE AND LIME-SULFUR WASH

BY

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Opelika, Ala.:
The Post Publishing Company,
1909

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THE SAN JOSE SCALE AND ITS WORK.

[Fig. 1.—Peach tree with top killed by the scale. Fig. 2.—Peach twig, moderately infested, showing male and female scale. Fig. 3.—Peach limb badly infested with scale. Fig. 2, enlarged 4 times; fig. 3, enlarged twice.] (After Quaintance, U. S. D. A. Year Book, 1905.)

THE SAN JOSE SCALE AND LIME-SULFUR WASH

BY

W. E. HINDS, PH. D.

Entomologist to Alabama Experiment Station.

ORCHARD INTERESTS OF ALABAMA.—The culture of orchard fruits, particularly peach, plum, pear and apple, is already a very important factor in the agricultural prosperity of Alabama. As nearly as we are able to estimate from the data available there are about 8,000,000 trees of these four kinds now growing in this State. Soil climate and market conditions are exceedingly favorable to a large increase in the growth of these fruits. The extension of the present important movement for the production of a greater diversity of crops, the substitution of other, and more profitable, crops for cotton and the adoption of improved methods for the culture of all crops grown will undoubtedly result in a great increase in fruit growing within the next few years. The growth of these fruits for wholesale commercial shipments and for the supply of the home markets as well, should increase largely as a profitable business proposition.

DANGER FROM SAN JOSE SCALE.—The principal difficulty to be met in maintaining present and in increasing future fruit culture is the necessity for controlling the insect enemies which, if left uncontrolled, may partially, or entirely, destroy the crops of fruit or even the life of the trees themselves. The most important insect affecting the four species of trees mentioned is the San Jose scale (pronounced "San Hosay") known scientifically as *Aspidiotus perniciosus* Comst. This is the most deadly enemy of fruit-growing known. The name itself means "most injurious scale" and it was well chosen.

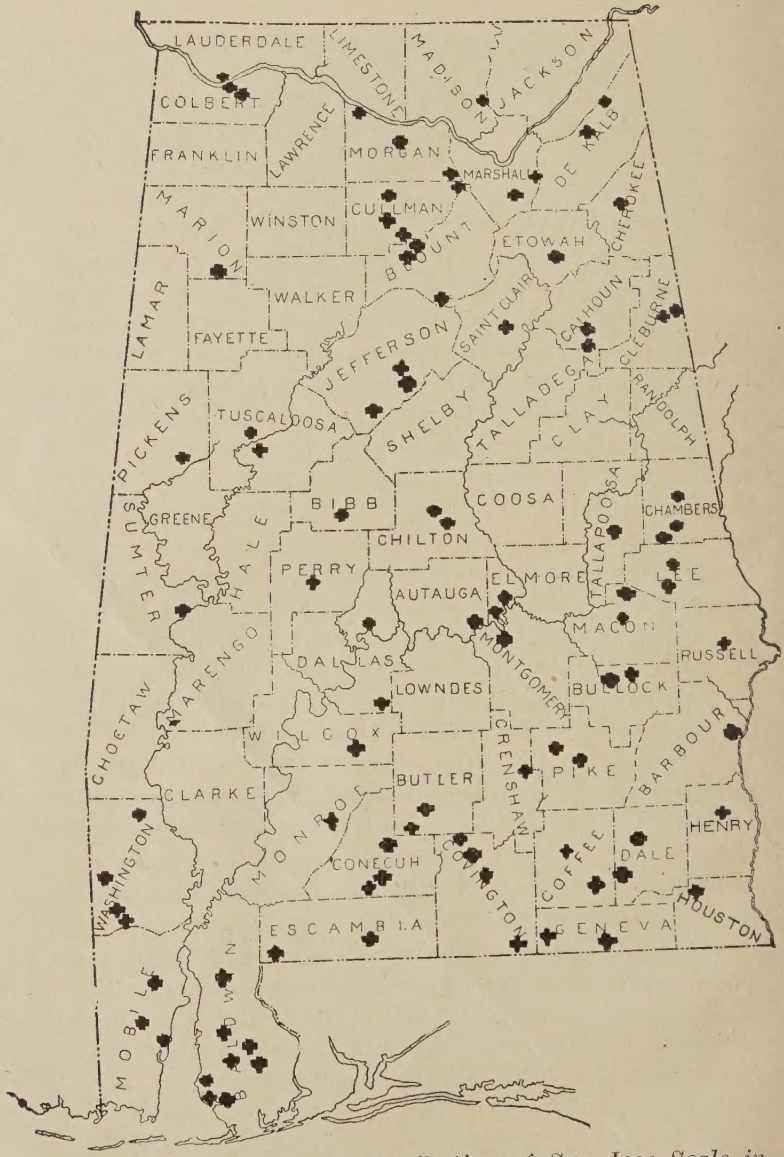

FIG. I. *Present known distribution of San Jose Scale in Alabama.*

INTRODUCTION AND SPREAD OF THE PEST.—This insect is not a native of the United States but appears to have been brought here from China where it occurs commonly upon native food plants. It was introduced into the San Jose Valley, California, about 1870 and the name of that locality where it was first found has been adopted as the common name of the scale. From California the species was brought on nursery stock into the eastern states shortly before 1893. It has since been spread by nursery stock shipments until it now occurs in nearly every State in the Union. During recent years, however, most of the States have passed strict laws requiring the inspection of nurseries for the occurrence of the scale and the fumigation of stock so as to kill any scales which might possibly exist there before the stock can be legally sold and distributed. The nurserymen have co-operated heartily in this effort to prevent the further spread of the pest so that now the buyer of fruit trees is very effectually protected against the planting of already infested trees. Orchards may be started today much more safely than they could ten years ago.

OCCURRENCE OF THE SCALE IN ALABAMA.—The known extent of its occurrence in this State is indicated upon the accompanying map (Fig. 1.). Without doubt it exists in many other places from which it has not yet been reported. Very frequently its presence in an orchard is not detected until some of the trees begin to die whereupon the cause of their death is sought for. A characteristic type of peach tree dying from this scale is shown in Plate I, fig. 1. The dying of the trees does not usually begin until some two or three years after the actual introduction of the scale and it has thus an opportunity to spread unchecked through the orchard.

WHAT IS THE SCALE.—The San Jose scale is a minute, inconspicuous insect which does not, to the untrained observer, appear to be a living creature. The body of the living insect is concealed beneath the circular, waxen scale which it forms for its protection. The largest scales

are smaller than an ordinary pin-head in diameter and are quite flat (See Pl. I, figs. 2 and 3). The scales are hardly more than 1-25 inch across and many of them are smaller still. Beneath the scale the body of the insect may be found as a small, immovable, yellow body (if still alive) which if crushed seems to be filled with a rather thin, yellow, oily liquid. The young of this species are born alive and their powers of reproduction are so remarkable that a tree bearing but few live scales in the Spring may become quite heavily infested by Fall and will then be liable to severe injury during the following season unless some method of destroying the scales is used during the winter.

Close observation with the naked eye shows that the scales are marked with rings of light and dark gray around a nearly black center. When very abundant they give a general ashy-gray appearance to the entire bark which is noticeable at some distance from the tree.

NATURE OF THE INJURY.—On living infested branches, especially on growth two or more years old, the surface becomes irregularly pitted or has depressions in spots where the scales are most abundant. The injury is of two kinds. Much sap is abstracted by the myriads of sucking insects, but more important than this is the effect which these scales have of causing a thickening of the cell walls which are penetrated by their slender mouth parts. This thickening checks the flow of sap in the branches, and this means the ultimate starvation of the parts of the branch beyond. The San Jose produces a distinctive red stain around the point of attack, either upon infested fruit or just under the scale in the bark. This appears upon lightly scraping off the outer bark.

NECESSITY FOR TREATMENT.—So serious is the injury of which this scale is capable that untreated, infested trees are certain to be killed within a very few years. The LIFE OF THE ORCHARD IS AT STAKE and the plain conclusion is evident that it is far more expensive to allow the trees to be destroyed than it would be to con-

trol the scale which can positively be done so as to continue the life of the orchard and the production of profitable crops. The average annual cost per tree for treatment depends mainly upon its size and ranges, for peach trees, from one-half cent to three cents, averaging between one and two cents. The man who will allow his total investment in trees, land and labor through three or four years to be absolutely destroyed for lack of an additional expense of a cent or two per tree each year, cannot be considered as conducting his work upon anything like business principles.

BEST METHOD OF TREATMENT.—The fight against the San Jose scale has developed several methods of treatment which are of positive value. Three points require consideration in determining which of these methods is best and should therefore be used. 1. Safety. 2. Efficiency. 3. Economy. The method which has been shown to best fulfill these conditions is "A WINTER SPRAYING WITH LIME-SULFUR WASH." In spite of numerous efforts to replace this Lime-Sulfur with some other material more easily prepared or less objectionable to handle in application, the fact remains that this is conceded by the great majority of orchardists, as well as by entomologists, to be the best treatment yet found.

It may be applied with safety at any time while the trees are in a dormant condition. A single thorough spraying with a properly prepared wash insures the control, if not the extermination, of the scale and is safer and more reliable than is any other treatment. The cost of treatment, varying in localities and with number of trees to be treated, need not exceed from one to thirty cents per tree according to their kind and size

SEASON FOR MAKING THE APPLICATION.—The safest and most effective time for treating trees for scale is during the dormant period, that is, between the time the leaves drop in the fall and the time the buds start in the spring. Experimental work has shown that a single treatment with Lime-Sulfur made in November or De-

cember is less effective than is a single treatment made in February or March, and that two treatments, one in the Fall and another just before the buds start, are but slightly more effective than is the later treatment alone. The exact time for spraying after January 1st may be decided by convenience as related to other work and by the continuance of the dormant condition of the buds.

A solution strong enough to kill the scale may be applied to the bark without injury at any time during the summer. It may be applied by painting or swabbing it onto the trunks and largest branches to check the summer development of the scale, but such a solution will destroy all foliage touched by it, and cannot therefore be sprayed on as in winter.

At about one-fifth of the strength recommended, however, it is thought by some that Lime-Sulfur can be sprayed upon even peach foliage which is fairly matured as at fruiting time, and that at that strength it will be a very effective agent in the prevention and control of the brown rot of peaches which is now one of the most serious problems in peach production in Alabama.

PREPARATION ON THE ORCHARD FOR TREATMENT.—This is a matter of considerable importance and the exact measures to be applied to each tree depend largely upon the degree of its infestation.

Slightly infested trees should be pruned before being treated as is best for their fruiting regardless of the presence of the scale. With heavily infested and badly injured trees, the pruning should be much more thorough. Trees which are nearly dead should be cut out and, in a young orchard, replaced if desired by new ones. All dead branches should be removed. Branches still alive but which have made very little growth during the preceding season should be strongly cut back, in some cases leaving them as mere "stubs" a foot or two long from the main trunk. If the cuts are more than three-fourths of an inch in diameter their surfaces should be painted over with White Lead. If there is still life enough in the tree

a new top may be formed out of several of the best and most vigorous shoots thrown out from these "stubs." In many cases it may be possible to control the scale and to thus renew the top of badly injured trees, so as to have them again of good size and bearing more fruit in two or three years than would young trees if put in their places. This is entirely a question of orchard management for the quickest and best production of fruit. It is certain that the scale may be controlled so the age and condition of the tree, etc., must decide the question whether it should be pruned and kept or cut out. It is advisable to burn removed trees and branches to get them out of the way and to prevent further spread of insect pests from them to living trees. The scale is not liable to spread if the trees and prunings are not burned but other injurious insects which may breed in the dead wood may spread from them, particularly to scale injured trees and thus cause the death of trees which might otherwise be saved from the scale.

Adjacent thickets or trees of wild plums or cherry, etc., should be cut and burned. Beside the trees mentioned many others are liable to attack by this scale. The following are some of those occurring commonly: Crab apple, apricot, persimmon, several kinds of walnut and of poplar, osage orange, chestnut, sumac, catalpa, cedar, several of the willows, ash, elm, pecan, orange, lemon, strawberry, gooseberry, currant, etc.

The Lime-Sulfur Treatment.—This wash has been very extensively used in California during the past twenty years. In the eastern United States since about 1900 it has been recognized as the best agent for destroying San Jose scale. Its effectiveness depends upon a chemical combination of the lime and sulfur which is brought about practically only under high temperatures. In a general way, if the chemicals are pure, we may reckon upon using practically equal portions of lime and of sulfur. In practice, however, it has been found better to use a somewhat larger quantity of lime, since commer-

cial rock lime varies somewhat in purity and is cheap. The excess of lime simply forms a whitewash which shows plainly the trees that have been treated. An excess of sulfur would remain undissolved in the solution. While this would do no harm, its presence would do no good and it might be considered as a needless item of waste. Both lime and sulfur are effective for some insects and fungi when used separately, but when combined they act far more efficiently. The principal object in making the wash is to produce economically a safe and thoroughly effective spraying solution.

In planning for making and using this wash a number of practical points require consideration for best results.

ESTIMATION OF QUANTITIES OF CHEMICALS NEEDED.—Naturally this is a difficult matter for the man who has never used anything of the kind. The first consideration is the number and the average size of the trees to be treated. If the scale is known to occur anywhere in an orchard, the only safe thing to do is to spray all trees in it, and the treatment should include at least all of our fruit trees which shed their leaves in the Fall. The amount of spray required will obviously depend directly upon the size of the tree. We may take average three to four-year-old peach trees as our standard and estimate that such trees will require about one-half gallon of spray each for thorough work, and no other kind of work is worth while. Each gallon of spray solution will therefore treat two medium-sized trees, while large trees may require two gallons each. In this way an approximate estimate may be made of the number of gallons of spraying solution to be prepared.

The question of formula must be next considered. As a result of a vast amount of experimental and practical work, it appears that the following formula is safe, efficient and economical:

Rock lime	20 lbs.
Flowers of Sulfur or Sulfur Flour	15 lbs.
Water to make	50 gallons

In ordering our chemicals therefore we reckon upon 20 lbs. of lime and 15 lbs. of sulfur for every 50 gallons of spraying solution which we have estimated to be needed. Emphasis should be laid upon the ultimate economy of using only the best and purest chemicals obtainable, regardless of their slightly greater initial cost.

LIME.—This means always freshly burned rock lime or quick lime. The test of quality is the slaking. Good limes should not contain more than ten per cent of impurities. Poor limes may contain 25 per cent of impurities. It is partly on account of these varying percentages of impurities that more lime than sulfur is used in the formula given. A good lime will slake readily and form an even creamy solution with little sediment or coarse matter which is waste.

Much first-class lime is produced in Alabama, particularly that made in the vicinity of Calera. The addresses of several manufacturers may be found in the Appendix on page 20.

The best grade of lime is shipped and handled in barrels. This is the best form in which to buy it, and the cost should not exceed about $1.00 per barrel or 1c per pound for our spray formula. In nearly every town may be found someone who handles a good grade of lime.

SULFUR.—The sulfur used must be very finely powdered to combine readily and completely with the lime in the making of the wash. Two forms of sulfur to be found on the market are perfectly pure and answer this need equally well. The "Flowers of Sulfur" is the finest form and is largely used, but may cost slightly more than does "Sulfur Flour" or "Flour Sulfur" as it is called. The choice between these two depends upon availability and price. Either should be obtainable at about five cents per pound in lots of fifteen pounds or more. If not obtainable at a satisfactory price through local druggists, sulfur may be secured through the wholesale drug firms listed in the Appendix page 20, and from other firms probably as well. Crystalline Sulfur should not be used under any

circumstances, since it is so coarse that it will not combine completely with the lime even with prolonged boiling. The result is a direct waste of sulfur and a wash solution that is liable to contain too little sulfur to be efficient, thus wasting all the chemicals, the labor of application and possibly, too, the life of the trees through ineffective treatment.

PREPARATION OF THE WASH.—For this work some facility for boiling the solution is essential. Where it is to be made on a small scale, and even in the treatment of several thousand trees where only one barrel pump is to be supplied, the cooking may be done quite conveniently in two large cast iron kettles, one of which may hold about 20 to 25 gallons, while the other should hold 40 gallons. The smaller kettle can be used in heating water while the lime and sulfur are being boiled in the larger one. For treatment of from 5,000 to 10,000 trees it is better to have larger kettles holding 75 to 80 gallons and mounted in a brick frame work or furnace. The cooking should be done when possible near a convenient water supply, but it is better to haul the water than the wash. For more than 10,000 trees it will be far better to cook the wash by steam supplied directly from a portable boiler or some such source. the cooking may then be done in barrels placed side by side and preferably upon an elevated platform. The essential point is that the boiler supply about one horse power for each barrel to be boiled with about 30% surplus power for the pumping and heating of water, etc. Wherever possible the water supply and the cooking barrels should be elevated sufficiently to utilize gravity in the flow of the liquids into the cooking barrels and from them into the spray tanks.

The kettle method of preparation will be described particularly as it may be more commonly employed in this State. Much latitude is permissible in the details of the preparation for the cooking. The essential points are to secure the complete and rapid slaking of the lime and the mixture of the sulfur with the lime solution without the

lumping of the sulfur. To avoid this the sulfur should always be mixed to a thin paste with hot water before being poured into the large boiling kettle. If this be done it makes little difference in the final result whether it be added before, after or during the slaking of the lime. The following method is as good as any and easy to follow:

For each 50-gallon lot of spray solution to be prepared mix 15 lbs. of fine sulfur to a thin paste in hot water in some convenient receptacle. Heat about 12 to 15 gallons of water in the 40-gallon kettle and while it is heating add the sulfur paste taking care to break up any lumps that may exist. Then add, lump by lump, the 20 lbs. of best rock lime. By the time the lime is all slaked the solution should be boiling hot. Add about 10 gallons more of hot water and continue the boiling steadily for about one hour. During this time the mixture must be stirred almost constantly to keep it from burning and to insure the complete solution of the sulfur. When properly prepared there should be no residue of sulfur after this cooking. The wash will appear as a rather thick, reddish brown, or dark orange-colored liquid. It gives off a strong odor of sulfur and is caustic in its action. Impurities in the lime may vary the color of the liquid, as does also the excess amount of lime but a variation in color need not affect its efficiency if the wash has been properly stirred and boiled.

From the boiling kettle the wash goes to the spraying barrel into which it should be strained through a brass strainer having about 20 meshes per inch. See fig. 2. This may be purchased or made at home. The strainer should remove all impurities which might clog the nozzles and delay the work in spraying. Never strain the wash through burlap bagging as the lint from the bagging will soon clog the pump. In the barrel the wash may be finally diluted with cold, but preferably with hot, water to make the required 50 gallons of spraying solution. The amounts of lime and sulfur may be varied,

still keeping the proportion between them, in preparing larger or smaller quantities of the wash as may be needed. In general it is better to spray the wash while it is still

Fig. 2.

warm or quite hot. It works easier in the pump and by the time the spray reaches the tree it is cooled so that there is no danger of its doing injury. It is generally considered as desirable to use the wash upon the day it is prepared but this does not seem to be absolutely necessary. Undiluted wash standing till cold will crystalize out the crystals may be again dissolved by reheating thoroughly and the wash is then probably just as good for use as ever.

SPRAYING OUTFIT.—While it is possible to apply the wash by painting or swabbing it onto the trunks and larger branches. the smaller branches and twigs cannot be thoroughly treated in this way and this method of application is so wasteful of time and materials that it will be found more economical as well as efficient to do the work with a "bucket pump" such as may be bought for about $6.00. This may serve fairly for the treatment of from 25 to 50 trees if they are small but for large trees,

or more of them, every orchardist should have a "barrel pump." These may be had in different sizes and full de-

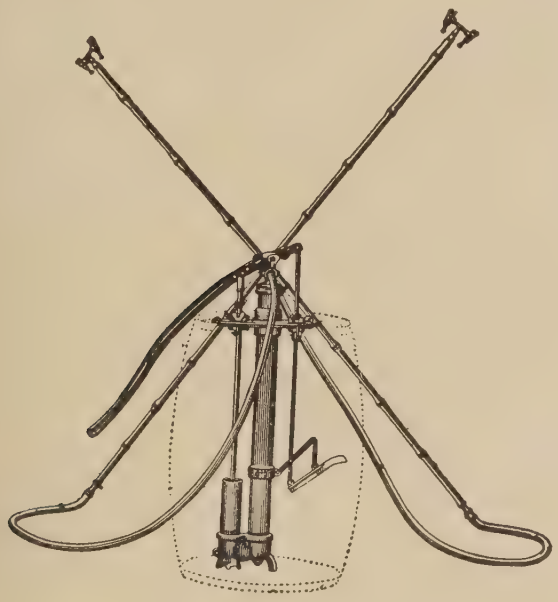

Fig. 3.

scriptions may be found in the catalogs of the various dealers whose addresses are given in the Appendix on page 20–21.

In selecting an outfit for Lime-Sulfur work it is essential that all of the working parts of the pump be of brass and that there be no leather packings or valves. The caustic action of the wash soon corrodes copper and destroys leather but affects brass only slowly. The best apparatus is the cheapest in this case. The most economical outfit for the average orchardist is a barrel pump that is powerful enough to carry two lines of hose with strong pressure for four nozzles. (See fig. 3).

The barrel in which the pump is mounted may well be an ordinary 50-gallon oil barrel such as may be obtained in any town and the mounting of the pump is a simple

operation. The hose should be one-half inch in diameter, inside measure, and of at least four-ply stock. Such hose may be secured of some of the firms mentioned at from 12 to 15 cents per foot. The best hose is not liable to burst under the pressure from the pump and will last much longer than cheaper grades. The length of hose usually furnished by manufacturers with their pumps is too short for satisfactory use. About 25 feet is a good working length for each line as it allows the sprayers more range and insures more rapid and more thorough work which more than offsets the slight extra cost for the longer hose. Each line should be provided with an extension rod from 6 to 12 feet long according to the size of the trees to be treated. There should be two "cut-offs" for each line of hose: one between the pump and the hose and the other between the hose and the extension rod. These save time and liquid and it is more economical to have them than to work without them.

The kind of nozzle to be used is a very important matter. That throwing the best spray is known as the "double Vermorel." There are several types of this nozzle made by various manufacturers which accomplish very similar results. One of these is shown in fig. 4. The

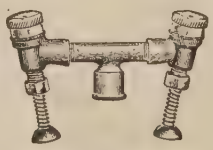

Fig. 4.

nozzle should be provided with plungers to clean them when they become clogged as is liable to happen occasionally even if the wash has been properly strained. The nozzle caps for Lime-Sulfur work should have an opening of 1-16 inch and extra caps should be kept on hand to replace old ones when they become worn so that they throw too coarse a spray. The pressure from the pump should be kept *strong* and especially when four nozzles

are being supplied care must be exercised to see that the pumper does not take his work too easily. The barrel outfit may be carried through the orchard in any kind of a one-horse wagon or on a drag. The driver does the pumping while a man is needed on the ground for each line of hose.

A thoroughly good outfit such as has been described will cost about $25.00 and with proper care it should last for a number of years. It will serve equally well in the application of all arsenical poisons for leaf and fruit feeding insects or for those attacking many of the garden or field crops. It may also be used for whitewashing. Altogether such an outfit is one of the most profitable pieces of equipment that any orchardist can own. Its intelligent use will go farther toward the production of *profits* with almost any crop than can any equal expenditure made in other ways without the spraying.

Information regarding "power sprayers" may be had from the catalogs of manufacturers and suggestions regarding them will be gladly given anyone upon application to the Entomologist, Alabama Experiment Station, Auburn, Ala.

SPRAYING SUGGESTIONS.—While much in regard to spraying can be learned only from experience, there are many suggestions that may be of aid to the beginner.

Only the most careful work is worth doing at all. Care should be taken to cover the twigs and small branches as thoroughly as the larger branches and trunks. If the tree is completely dormant, heavy drenching with the wash will not injure it and it is better to use more spray than is really needed than to use too little to do the work thoroughly. Do not undertake to spray when the prospects are for an immediate storm or severe cold spell since if these should occur before the wash has dried thoroughly on the trees the work will have to be repeated to be effective. Good work cannot be done when a strong wind is blowing. Select fair, calm weather for the work whenever possible or else make a second treatment when it is

calm or when the wind is blowing from the opposite direction to that during the first spraying. The spray solution must be continually agitated during the spraying and a properly constructed pump will accomplish this.

The disagreeable effects of getting the wash on the skin may be reduced by rubbing the hands and face with vaseline before spraying. Rubber coats and gloves are, of course, the best protection for the sprayers but if not available old clothes should be worn so that they may be discarded after the work is finished. Cheap canvas work gloves are a satisfactory protection for the hands. The mules, or horses, and the harness may well be protected by blankets made of old burlap sacks.

After the days work is over the remaining solution should be drawn or emptied out and clear water run through the pump, hose and nozzles to leave them in clean condition and reduce the corrosive injury to the outfit which would otherwise be as great through a night of standing as through a day of use. This cleaning should be particularly thorough at the end of each seasons work or when the apparatus is to be stored for any length of time. All working parts should be kept thoroughly oiled. These measures of care will reduce the expenses for repairs and improve the ease and quality of the work done.

General Usefulness of Lime-Sulfur Wash.—Its superior power of controlling the San Jose scale is but one of the many advantages of this wash. It adheres to the trees for a long time and its good effects are continued through several months after the application. It acts both as an insecticide and also as a fungicide.

As an insecticide it is effective for nearly all of the scale insects oscurring upon fruit trees. It destroys the winter eggs of the plant lice which attack the leaves and twigs of apple so abundantly in the Spring. It also controls the "pear-tree Psylla" and the "pear-leaf blister mite" as well as the ,'silvering mite" of the peach and the "peach-twig borer."

At the same time as a fungicide it is exceedingly effec-

tive against the "peach-leaf curl" and the "brown rot," also for the "apple scab" and "pear scab" and other fungous diseases of fruits.

These fruit pests cannot all be reached at the same time with any other of the numerous methods of treatment which are sometimes substituted for the Lime-Sulfur for controlling the San Jose scale. No other insectitude now known can equal in range of usefulness and in economy a single thorough application of Lime-Sulfur wash to fruit trees just before the buds start in the Spring.

Manifestly these important considerations in favor of Lime-Sulfur far outweigh all contrary ones based upon the inconvenience in its preparation and the disagreeableness of handling and applying it. To obviate the objections to the preparation of the wash any one who desires may now buy it in a concentrated solution ready to dilute directly with water for spraying. It is sold by several of the manufacturers of insecticides whose addresses are given in the Appendix on page 21–22. This might be particularly desirable for the man who needs but little of the wash. The commercial article has shown up favorably in experimental tests but apparently has no superiority in effect over the home-made article which, of course, costs somewhat less.

Determination of Specimens and Special Advice.—Specimens suspected of being San Jose scale, and any other insects attacking fruits, trees, garden and field crops, etc., may be submitted to the Entomologist, Alabama Experiment Station, Auburn, Ala., for determination. They should be mailed in a tight, strong box bearing plainly on the outside the name and address of the sender and separate from the letter of advice which should describe as fully as possible the nature and extent of the injury which the insect seems to be doing. The Entomologist will gladly and freely give any suggestions possible for combating insect pests thus brought to his attention.

APPENDIX

INSECTICIDE MATERIALS AND SPRAYING APPARATUS: ADDRESSES OF DEALERS AND MANUFACTURERS.

Believing that much of the failure to adopt recommendations for spraying treatment for insect and fungus pests is due to a lack of definite knowledge as to just where reliable materials and equipment may be secured, we give below the addresses of some of the many firms manufacturing or dealing in insecticide materials and apparatus. In doing this we do not mean to imply that other dealers do not make or handle just as reliable and satisfactory goods. Those listed may be depended upon and are as accessible as possible to the people of Alabama.

Lime Works.

Newala Lime Works, Calera, Ala.
Calera Lime Works, Calera, Ala.
Keystone Lime Works, Calera, Ala.
Longview Lime Works, Calera, Ala.

Wholesale Sulfur Dealers.

Durr Drug Co., Montgomery, Ala.
Greil Bros., Montgomery, Ala.
Jacob's Pharmacy, Wholesale Department, Atlanta, Ga.
Mobile Drug Co., Mobile, Ala.

Spraying Machinery.

Morrill and Morley, Benton Harbor, Mich. (Local agency G. W. Barnett Hardware Co., Montgomery, Ala.)

Goulds Mfg. Co., Seneca Falls, N. Y. (Goods handled by Beck & Gregg Hardware Co., Atlanta, Ga.; Alabama Machinery & Supply Co., Montgomery, Ala.)

The Deming Co., Salem, Ohio. (No local agency so far as we know.)

Frost Insecticide Co., Arlington, Mass. (No local agency.)

Dayton Supply Co., Dayton, Ohio. (Agency with Macon Implement Co., Macon, Ga.; Alabama agencies are being established also.)

F. E. Myers & Bro., Ashland, Ohio. (Agencies with Barney-Cavenaugh Hardware Co., Mobile, Ala.; Selma Hardware Co., Selma, Ala.; and Alabama Machinery & Supply Co., Montgomery, Ala.)

Insecticide Manufacturers and Dealers.

Graselli Chemical Co., Birmingham, Ala. (Make and sell Lime-Sulfur solution, Arsenate of Lead, Bordeaux mixture, etc.)

Bowker Insecticide Co., 43 Chatham St., Boston, Mass. (Sell a number of kinds of specially prepared insecticides.)

Frost Insecticide Co., Arlington, Mass.

Rex Co., Omaha, Nebraska. (Sell Lime-Sulfur solution and Arsenate of Lead particularly.)

Thomsen Chemical Co., Baltimore, Md. (Sell Lime-Sulfur solution.)

Fred. L. Lavanburg, 100 William St., New York, N. Y. (For Paris Green and Arsenate of Lead particularly.)

Merrimac Chemical Co., 33 Broad St., Boston, Mass. (Makers of Swift's Arsenate of Lead.)

Adler Color & Chemical Co., New York, N. Y. (Make Paris Green, Arsenate of Lead, etc.)

Acme Color Works, 100 William Sreet, New York, N. Y. (Paris Green, etc.)

A. B. Ansbacher & Co., New York, N. Y. (Paris Green, etc.)

F. W. Devoe & Co., New York, N. Y. (Paris Green, etc.)

Leggett & Brother, New York, N. Y. (Various insecticides.)

Sherwin-Williams Co., Newark, N. J. (Paris Green.)

American Horticultural Distributing Co., Martinsburg, W. Va. ("Target Brand" insecticides.)

B. G. Pratt Co., 11 Broadway, New York, N. Y. (Scalecide.)